Wolfgang Falb
Hubertusstr. 1
80639 München
Germany
Tel. +49 89 1799 8150
Fax +49 89 1708170
wolf@life-marine.de

TITLE OF THE INVENTION

ELECTRICALLY POWERED BOOM VANG FOR A SAILBOAT

CROSS REFERENCE TO RELATED APPLICATIONS

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STATEMENT REGARDING FEDERALLY SPONSORED RESAERCH OR DEVELOPMENT

Not Applicable

REFERENCE TO SEQUENCE LISTING, A TABLE, OR A COMPUTER PROGRAM LISTING, ..

Not Applicable

SPECIFICATION

BACKGROUND OF THE INVENTION

This invention relates to an electrically powered boom vang for a sailing vessel.

Typically, a sailboat boom extends at an approximate right angle to the vertical mast and is connected to the mast by a gooseneck with a toggle and a swivel joint, allowing the boom to swing horizontally and being lowered or raised at the rear end. Without a rigid vang and with sails down the boom is held by a topping lift fitted to the vessel. With raised sails the boom is held upward by the main sail. Especially when sailing downwind or on a reach, air pressure against the mainsail forces it to bulge and causes the end of the boom to rise.
So a vang, an adjustable device or mechanism secured between the forward portion of the mainsail boom and a location near the base of the mast is used to keep the boom under control. Until a few years ago typical boom vangs were line-purchase systems, distinct from that of the main-sheet, including two or more blocks or pulleys attached to the boom, and a single line having one end secured to one of the pulley systems, with the line having a free end which is pulled out and released manually by the sailor.
To support the boom while the main sail is down and therefore eliminating the topping lift, or to counterbalance the boom in very light wind conditions to maintain an optimum shape of the sail, these line-purchase systems were then supplemented by a mechanical vang. Whereas the line-purchase system could only apply pulling force, the mechanical vang, consisting of a telescopic strut with two tubular members connected by a spring, applied, when retracted, lifting force to the boom. However, this means that the spring force must be overcome in order to trim the sail.
There are also hydraulic driven boom vangs in use, but these systems, due to price, weight and complexity are generally found only on bigger yachts with already installed hydraulic systems.

Upcoming modern sailing cloth of high strength and precise computer aided design require more precise sail trim to be efficient than with the traditional materials. Also, there is a tendency lately to control the heel of sailing boats by trimming the trailing edge (leech) of the sail, rather than with the main sheet. This new technique, called VANG SHEETING allows by altering the height of the rear end of the boom to tighten or release the leech of the sail (adding twist), thus controlling airflow in the upper third of the sail where wind and heeling force are strongest. The use of the vang enables the mainsail to be flattened independently of mainsheet tension and as the wind increases to depower the mainsail to control heel.

As pointed out, modern sailing cloth and the growing awareness to efficiently exploit the natural power of wind has led to the use of rigid vangs rather as trimming devices than just to keep the boom under control. It is obvious that fine tuning the boom works best the more power one could apply to it. In traditional systems this could be achieved by applying more blocks or pulleys. The disadvantages then are the need for long lines, loss of efficiency due to friction, the need for strong springs which have to be overcome when handling the boom vang. Further, the complete system from the boom fitting to the line stopper in the cockpit is under constant strain. A good ratio for the line-purchase system would be 8:1. Assuming a manual pulling power of 50 kg and a loss due to friction of 25% would result in a pulling force of 300 kg, the effective vertical part of this force applied to the boom at this point would then be only 212 kg. The operative downward force to the sail leech with a typical length ratio from mast to boom vang fitting to the overall boom length of 4:1 would leave only something more than 50 kg at the trailing end of the sail. This is little for precise trimming even in moderate winds.

On bigger yachts hydraulic systems are in use which serve the power for boom vangs and other devices as winches, backstay regulators, anchor windlasses etc.. However, medium seized sailing boats and even many bigger sailboats do not have a hydraulic system, due to costs, weight and maintenance. Until now they have to use line driven systems with the limitations as outlined above.

The electrically driven Boom Vang described in this invention enables them now to trim their sails with the same power, but without the complexity of hydraulic systems.

See also:

Literature:

"Use of vang enables the mainsail to be flattened independently of mainsheet tension, and it is the most effective of all controls for dynamic tuning." "As the windspeed increases in each gust, in flat water we use the vang as the primary control to flatten and depower the mainsail on a gust by gust basis."

Frank Bethwaite "High Performance Sailing" Pp. 222/294

Internet:

Links to Vang Sheeting

http://www.life-marine.de/html/Links_Vangsheeting.htm

BRIEF SUMMARY OF THE INVENTION

The present invention comprises a telescopic rigid boom vang as trimming device for sailboats where the extension of the device is conrolled by at least one electric motor with a planetary gear coupled to a threaded rod.

The boom vang consists of an outer and an inner tube with one of them fixed to the boom the other to the mastbase. One tube, preferably the one connected to the mastbase houses at least one electric motor docked to a planetary gear which is engaged to a threaded rod. The rod is longitudinally fixed to this wider tube by thrust bearings to release forces from the driving shaft. At the outer side the rod is threaded to a smaller tubular device containing a round drive nut on the inner end. Both tubes outer ends contain mounting devices for the rig, like a clevis with or without an adapting collar on the outer end, so that both tubes cannot rotate but turn vertically and/or horizontally around the boom and/or mast.

To keep the extension part of the telescopic tubes aligned to the rod, the rod carries a disk bearing at the outer end which fits into this tube. So when this extension tube is threaded on the rod it is held in line by this disk bearing on one end and by its inner round drive nut on the other end. To keep both tubes aligned to each other, the wider tube with the fixed rod has an inner sliding sleeve at the outer end which encloses the smaller tube. To support the other end, the round driving nut of the extension tube has an outer shoulder which fits closely to the inner wall of the wider tube.

Thus, running the electric motor(s) will turn the threaded rod inside the drive nut of the extension tube and apply movement between the outer ends of the boom vang, applying forces to boom & mast. When the power is turned off and with the right pitch, the thread is self locking, regardless of the pressure on the ends it will not contract or extend itself.

The advantages of the described boom vang compared to line pulley systems with a spring are, that it applies more power, that the power can be metered precisely and that the thread drive is safer and more convenient to use.

A linear drive with threaded rod has less friction and a much greater purchase than having long lines running around several blocks and pulleys as in common boom vang systems. Also there is no counterforce to overcome as with spring loaded systems.

One of the most dangerous tasks for a sailor is packing the sails either for reefing or binding the sails to the boom on sea, because this cannot be done with one hand (and the other for the boat). So usually the sailor leans the upper body upon or against the boom which is then usually horizontally fixed by the mainsheet and grabs the sail cloth with both arms to bind it to the boom. This only can be done safely when the boom, under the body's weight, doesn't move downward, which is usually the case with spring loaded systems. So the inherent self locking ability of a thread driven system adds important safety, especially in rough sea when the boat is in a rolling movement.

The advantages of the described boom vang compared to single hydraulic boom vang are that it is less complex, has less weight, needs less maintenance and is less expensive. This applies to boats even where a hydraulic system is already installed for other devices.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. 1 is a diagram showing a vang, in accordance with the invention, and its connections to the main-boom and main-mast of a yacht. An extended vang is shown with broken lines. FIG. 1 represents the frontpage view;

FIG. 2 is a view of an assembled thread driven boom vang with one electric motor, where the tubes are partly opened and where a cross section view of the housing for the bearings, holding the flange of the threaded rod is shown;

FIG. 3 is an enlarged view of the gear drive shaft end connected to the flange of the threaded rod and a cross section view of the bearings with the housing which is connected to the outer tube. It also shows part of the drive nut with shoulders, threaded onto the rod;

FIG. 4 is a view of an assembled thread driven boom vang as in FIG. 2, but with two electric motors, connected together by a coupling;

FIG. 5 is an enlarged cross-section view of the clevis end showing the motors head fitting in a tunnel which is also the room for the motor cables which connects to the electrical socket.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

A rigid vang **1** according to this description fitted to a boom **2** and a mast **3** is shown in **FIG.1**. A dotted line indicates the lifted boom **4** when the vang is extended **5**. An electric cable **6** leads from a plug socket **37** at the clevis base **7** of the vang to a socket **8** on the deck.

In **FIG. 2** an assembled boom vang **9** with one electric motor **10** and a partly opened base tube **11** and extension tube **12** with a cross section of the bearing case **13** is shown.

A clevis end **7** with a pin hole **14** to be mounted to the mast bracket **15** with a socket plug **37** for electric connection is bolted or screwed to the base tube **11**. At least one electric 12 V DC motor **10** with an adapted planetary gear **16** is bolted or screwed **17** inside the tube to the front section **18** of a bearing case. The driving end **19** of the planetary gear is engaged to a flange **20** inside the bearing case. The flange itself is fixed by a screw or bolt **21** to a threaded rod **22**. The main part of the bearing house **23** fits two thrust bearings **24** at each side of the threaded rods flange **20** and preferably one bushing type bearing **25** at a fine lathed part of the rod **36**. The housing is held to the base tube **11** by radial mounted bolts or screws **26**. To protect the unit and the electric components against the environment a retaining ring **27**, fitted to one end of the housing, seals a lathed part of the threaded rod **36**. Additionaly at least one o-ring seal **28** is set in a groove in the outer part of the housing, sealing to the inner wall of the base tube. So when the power is on, the electric motor(s) **10** will turn the threaded rod **22**. All torque forces are held by the radial mounted screws or bolts **26** of the bearing case and the tube. Also all longitudinal forces applied by the threaded rod to a drive nut **29** mounted in the extension arm **12** are also held by the bearing case fixed to the tube. To keep the motor(s) with the planetary gear **16** and the bearing case centered inside the tube, in this preferred embodiment the motor housing as seen in **FIG. 5, 30** fits into an inlet **38** of the clevis end. As there are no forces to compensate on the motor housing, a spacer around the housing would center the motor also. The motor cables **40** are led also through this inlet and are connected to a socket **37** which is machined into the clevis end.

The outlined assembly of the components makes it easy to pull out all parts of the unit for repair or inspection by removing only the screws or bolts **26** to the bearing case **23** and to the clevis end **7**.

The threaded rod **22** leaving the bearing case, threads into a drive nut **29**, glued or bolted to the inner end of the extension tube. The drive nut, preferable made of a high strength plastic with low friction factor has an outer shoulder **31** for centering and smooth gliding on the inner wall of the base tube. Threaded rods are susceptible to bending under high pressure, so it is necessary to support the outer end of the rod inside the extension tube even further with a disc bearing **32**. To complete safe linear movement, a bushing-type bearing **33** is fixed inside the outer end of the base tube, enabling centering and easy movement of the the inner extension tube. Fixed properly this bushing can not be passed by the shoulder **31** of the drive nut **29**, thus limits the maximum extension. Reaching this bushing, the drive nuts shoulder will let the motor stall; the resulting electrical overload then can be used to trigger a circuit overload protection.

Adjustments:

The use of two 12 Volt DC motors as in **FIG.4** will double the power and keep the units diameter less wide. With alternatly switching (from series to parallel) a double motor unit can be operated with 12 or 24 Volts. Also redundance will then add operational safety. There are two ways to upgrade the unit with a second motor: either by changing the base tube to a longer one **34** with place for a second motor **35** and a coupling adapter **36** or to drill new holes and seal the old ones to accommodate the same.

Adjustments for another range in the length for use on a bigger boat for example can be done by changing the extension arm **12** with or without the driving nut **29**, depending how it was mounted to the tube.

Modern motor electronics enables one to monitor and control the many aspects of electric motors. One could define a certain position of extension **5** to return to or alter the extension when a determined pressure is reached. Using an electric trimming device is a more comfortable and flexible way to efficiently use the natural power of wind.